UNITED STATES PATENT OFFICE.

CARL KILLING, OF DUSSELDORF, GERMANY, ASSIGNOR, BY MESNE ASSIGNMENTS, TO THE UNITED STATES NOMATCH LIGHT COMPANY, OF WEST VIRGINIA.

MANTLE FOR INCANDESCENT GAS-BURNERS.

SPECIFICATION forming part of Letters Patent No. 614,555, dated November 22, 1898.

Application filed March 5, 1897. Serial No. 626,089. (No model.)

To all whom it may concern:

Be it known that I, CARL KILLING, a citizen of the German Empire, residing at Dusseldorf, Germany, have invented certain new and useful Improvements in Mantles for Incandescent Gas-Burners, of which the following is a specification.

This invention has been patented to me in the following countries: Italy July 15, 1896, No. 42,115; additional patent December 16, 1896, No. 43,316; France July 8, 1896, No. 257,921; Belgium July 8, 1896, No. 122,400; additional patent December 16, 1896, No. 125,216, and Luxemburg July 14, 1896, No. 2,560.

My invention pertains to mantles for use with gas for producing light by incandescence; and it consists in mechanically combining with a relatively large body of thorium oxid a relatively small or minute quantity of a metal of the platinum group applied in solution, and consequently present in an infinitesimally small quantity over or throughout the entire mantle.

Prior to my invention it had been demonstrated that a mantle formed essentially or wholly of oxid of thorium could be rendered incandescent, but that its light-giving power was relatively low. It had further been shown that if the oxid of cerium was combined in relatively small quantity with the oxid of thorium the light-giving capacity of the mantle was greatly increased and was greater than the sum of that due to thorium and that due to cerium—in other words, the cerium was found to act upon and to excite the thorium or to have a catalytic effect, resulting in a marked increase in illuminating power. It was also supposed and was asserted that various other combinations or compounds possessed like properties, thorium oxid being usually proposed for the main body or ingredient with a small quantity of the oxid or oxids of one or more of such rare earths as yttrium, ytterbium, terbium, erbium or its elements, lanthanum, neodymium, samarium, and praseodymium oxids added thereto or mechanically combined therewith. I have found, however, by careful and thorough investigation that in the absence of cerium none of the earths mentioned have the power of appreciably increasing the light-giving effect of a mantle of thorium oxid or the like and that wherever such result has seemingly been attained it has been due to the presence of at least a trace of cerium, an exceedingly small quantity of which will give beneficial results.

Oxid of cerium is of all known rare earths the only one existing as peroxid and as protoxid. To this circumstance is due the fact that oxid of cerium can transmit oxygen to gas, this being oxidized, while peroxid of cerium is reduced to protoxid, which by the oxygen of air is retransformed to peroxid, this being able to oxidize the gas or to burn the gas, and so on.

So far as I am aware no one has hitherto been able to produce the effects noted otherwise than through the employment of a salt or an oxid of a rare earth, such as cerium, and according to my own investigation they are attainable with the salt or the oxid of no other substance than cerium. I have, however, discovered that metals of the platinum group, which do not exist in the ashed mantles either as salts or as oxids, but which may be brought in the form of chlorids to the unashed mantles, and thus used in solutions, mixtures, or compounds, have, when the chlorids are ashed, an effect similar to that produced by the oxid of cerium. I have also ascertained that notwithstanding the fact that these metals are more expensive than cerium oxid, weight for weight, they may nevertheless be used in so much smaller quantity as to reduce the cost of mantles materially as compared with those in which cerium is employed.

The theory upon which my experiments were made and the above-indicated result was reached is that the metal employed—platinum, iridium, or the like—having a strong affinity for oxygen, which it attracts and holds upon its surface, so that it can be transmitted, but with which it does not chemically combine, collects and maintains a large supply of oxygen over the surface of

the mantle, and this oxygen, uniting with the gas of the burner and supplied constantly to the burning gas, causes a far more perfect combustion, and consequently much higher temperature, than would be possible from the combustion of merely the mingled gas and atmospheric air of the burner. This greater heat more readily and more perfectly produces incandescence of the thorium mantle, which latter serves merely as a radiating, diffusing, or distributing body for throwing off the light so produced. It is apparently true also that the metal, though present in such minute quantity, itself adds to the radiating capacity of the mantle.

The precise mode or method of making the mantle is not essential; but I prefer in practice to first knit or otherwise produce the body of cotton or other suitable filamentary substance, impregnate this with a solution of thorium oxid, and thereafter, either before or after burning out the mantle, dip it into or pour over its surface a solution of the salt of a metal of the platinum group. The mantle is then dried and heated again, so that the chlorid of platinum or of iridium is transformed to metallic platinum or iridium, which, however, is present in such infinitesimally small quantity and is so distributed through the mass that its presence is discoverable only by the catalytic or oxygenizing action which it effects and which is not produced in its absence. Some slight variation in the quantity of metal is permissible, but only within narrow limits. Thus if the proportion be reduced to 0.02 of one per cent. or increased to 0.08 of one per cent. the oxygenizing or catalytic action of the metal wholly disappears, but gradually reappears as the proportion of 0.04 of one per cent. is approached. I therefore mean to claim the proportions herein stated or a variation within the comparatively narrow limits just indicated. In this way the surface is coated and the metal is exposed where it is needed instead of being incorporated in and hidden by the thorium oxid. I may, however, incorporate the salt of the metal in the thorium solution and so apply it to the mantle in the act of applying the thorium.

The preferred mode of preparation and the proportions which have thus far afforded the most satisfactory results are as follows: A body of cotton or other fibrous material is produced in any of the customary ways to serve as a foundation and is immersed in or otherwise saturated or impregnated with a solution of nitrate of thorium, to which is added one drop of platinum chlorid, (one to ten.) The thorium solution is formed by dissolving four grams of nitrate of thorium in ten cubic centimeters of water. After being thus impregnated with the solution stated the cotton mantle is dried and burned out, leaving as the result of such treatment a mantle composed of 99.96 per cent. of thorium and 0.04 per cent. of platinum, approximately. In these proportions the mantle when rendered incandescent gives a light effect of high power, the light being of a yellowish color or tinge.

If it be desired to produce a very white light, there may be substituted for the one drop of platinum chlorid in the thorium solution eight drops of an iridium solution composed of thirty-three ten-thousandths of one gram (0.0033) of iridium chlorid in one cubic centimeter of water, and this will be found to give higher light effects.

Other metals of the platinum group may be used instead of platinum or iridium—as, for instance, gold, rhodium, and ruthenium—but for practical or commercial purposes platinum or iridium will generally be found best, because of their lasting qualities.

Only metals which do not readily vaporize should be used, and it is because of the difference in this regard of metals of the platinum group that platinum and iridium are preferred.

While preferring the mode of manufacture thus set forth, I do not mean to restrict myself thereto, since the metal may be introduced with the thorium or subsequently applied thereto, as above indicated. Nor do I deem material the theory or physical law upon which the effects stated depend, since the procedure stated will invariably produce the results stated, as demonstrated by many practical experiments and extensive commercial use. So, too, proportions may vary within reasonable limits; but I have stated those which have thus far proven best in actual use.

Two or more metals of the platinum group may be used together.

I am aware that it has been proposed to introduce into a mantle for incandescent gas-lighting a precious metal, such as gold or platinum, in such quantity that when the mantle is subjected to the necessary degree of heat said metal shall be fused and caused to produce in the mantle a fine thread-like skeleton of free metal for the purpose of giving strength and pliability to the mantle, and that it has likewise been proposed to apply the metal in the form of a solution to the exterior surface of a mantle and subsequently to bring it to the state of free metal by fusion. In both cases the object sought was the production of a metallic skeleton constituting the strength-giving portion of an incandescent mantle. I make no claim to such construction or use, but restrict myself to substantially the proportions herein stated, wherein the total amount of metal present in a mantle is so infinitesimally small that if aggregated in one particle it would be scarcely perceptible, if perceptible at all, as a free metal. It is a fact, demonstrated by repeated and careful scientific investigation and experiment, that if any metal of the group recited be present in a quantity materially in excess of four-hundredths of one per cent. of the weight of the solution or mixture applied to

the mantle skeleton there will be no more light emission than there would be in the entire absence of any metal of said group. In other words, the peculiar effect of absorbing oxygen from the atmosphere and supplying it to the thorium is attainable only when the metal is present in the exceedingly small proportion hereinbefore set forth.

The metals which I have found useful for the purposes of this invention are comprised within the platinum group. While some metals outside of said group possess the requisite properties to a limited degree, they do not, so far as my investigations have enabled me to observe, possess them sufficiently to permit the use of such metals in the manufacture of mantles for the trade. In other words, they are but theoretically useful and not practically so.

Having thus explained my invention, I claim—

1. As a new article of manufacture, a mantle for incandescent gas-lighting, consisting of thorium oxid and a metal of the platinum group, the metal being present in substantially the exceedingly small proportion stated.

2. A mantle for incandescent lighting consisting of a body of thorium oxid coated with a solution containing a metal of the platinum group in the exceedingly minute quantity specified, substantially as and for the purpose set forth.

3. A mantle for incandescent lighting, consisting of thorium oxid and a metal of the platinum group, said metal being present in substantially the proportion of four-hundredths of one per cent. relatively to the thorium, whereby a catalytic action is secured.

In witness whereof I hereunto set my hand in the presence of two witnesses.

CARL KILLING. [L. S.]

Witnesses:

THOS. ADAMS, Jr. [L. S.]

CHAS. A. SEDDON. [L. S.]